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Possibility of periodically reentrant superconductivity in ferromagnet/superconductor layered structures

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Abstract

We develop the theory of the proximity effect in layered ferromagnetic metal/superconductor (F/S) structures taking into account finite transparency of the F/S interface as well as depression of the Cooper pairing and diffusionlike motion of conduction electrons by a strong exchange field of the ferromagnet. It is shown that the oscillatory dependence of the critical temperature on the F-layer thickness is due to a periodic modulation of the F/S boundary transparency by the oscillations of pair amplitude within the F layer. It is possible not only in the F/S multilayers, but in the F/S bilayers as well. The phenomena of reentrant and periodically reentrant superconductivity in the F/S contacts and superlattices are predicted. The competition between the "0" phase and "ππ phase types of superconductivity in the F/S multilayers is also discussed.